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EP00/01929

REC'D 05 JUN 2000
WIPO PCT

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(4)

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Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

99250231.0

PRIORITY DOCUMENT

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Der Präsident des Europäischen Patentamts:
Im Auftrag

For the President of the European Patent Office

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Blatt 2 der Bescheinigung
Sheet 2 of the certificate
Page 2 de l'attestation

Anmeldung Nr.:
Application no.: 99250231.0
Demande n°:

Anmeldetag:
Date of filing: 13/07/99
Date de dépôt:

Anmelder:
Applicant(s):
Demandeur(s):
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Bezeichnung der Erfindung:
Title of the invention:
Titre de l'invention:
Method for implementing trickplay modes in a data stream recorder

In Anspruch genommene Priorität(en) / Priority(ies) claimed / Priorité(s) revendiquée(s)

Staat: State: Pays:	EP	Tag: Date: Date:	19/03/99	Aktenzeichen: File no. Numéro de dépôt:	EPA	99250083
Staat: State: Pays:	EP	Tag: Date: Date:	28/04/99	Aktenzeichen: File no. Numéro de dépôt:	EPA	99250139

Internationale Patentklassifikation:
International Patent classification:
Classification internationale des brevets:
/

Am Anmeldetag benannte Vertragstaaten:
Contracting states designated at date of filing: AT/BE/CH/CY/DE/DK/ES/FI/FR/GB/GR/IE/IT/LI/LU/MC/NL/PT/SE
Etats contractants désignés lors du depôt:

Bemerkungen:
Remarks:
Remarques:

Method for implementing trickplay modes in a data stream recorder

The invention relates to an improved trickplay processing for a data stream recorder, in particular a DVD based data stream recorder.

Background

Stream recording assumes an application device, e.g. a set-top box, connected to a DVD Streamer. Both devices are connected via e.g. an IEEE1394 (IEC 61883) interface including transmitting and receiving firmware.
Stream Data include one or more 'Stream Objects' which each can be stored as a 'Program Stream' as described in ISO/IEC 13818-1, Systems.
The following abbreviations are used in the description: APAT: application packet arrival time, ATS: application timestamp, AU: access unit, AUD: AU data, AUELL: access unit end location list, AUEM: access unit end map, AULL: access unit location list, AUSLL: access unit start location list, AUSM: access unit start map, DTS: decoding timestamp, DVD: digital versatile disc, DVD RTRW: DVD realtime rewritable, DVD VR: DVD video recording, IAPAT: incremental application packet arrival time, MAPL: mapping list, LB: logical block, PAT: packet arrival time, PES: packetised elementary stream, PTS: presentation timestamp, SCR: system clock reference, SOB: stream object, STB: set top box, S_PCK: stream pack, TOC: table of content.

A SOB can be terminated by a program_end_code. The value of the SCR field in the first pack of each SOB may be non-zero. A SOB contains the Stream Data packed into a sequence of Stream Packs. Stream data can be organised as one elementary stream and are carried in PES packets with a stream_id.

In Stream recording, the application performs its own padding so that the pack length adjustment methods of DVD-ROM Video or RTRW need not to be used. In Stream recording it is safe to assume, that the Stream packets will always have the necessary length.

Invention

The invention allows to realise Access Units. The resulting AUs have a resolution range from 2 SOBUs up to 'application packet' exact. The precision depends on the used DVD Streamer, i.e. whether the DVD Streamer knows the application and e.g. how much RAM memory is available. Therefore the precision depends on the design of the manufacturer.
Each SOB contains its own AU data. This AUD consists of a general information, one or two coarse lists and one or two fine lists.
The coarse list is called the Access Unit Start Map AUSM. The AUSM consists of N flags (N is the number of SOBUs of this SOB). Each flag belongs to one SOBU. The flag indicates that:

- an AU points into the corresponding SOBU or into the next SOBU;
- no corresponding AU exists for that flag.

A fine list is called the Access Unit Location List AULL and contains the exact locations of the application packets of all AUs. For each AU indicating AUSM/AUEM flag there exists one location information inside AULL.
Two kinds of AULLs exist:
The part inside the AULL containing the start location is called the Access Unit Start Location List AUSLL. The part inside the AULL containing the end location is called the Access Unit End Location List AUELL.
The complete AU information of an SOB consists of either

- the sector & application packet location of the start of the AU and
- the sector & application packet location of the end of the data which starts at the AU (e.g. the end of the I-frame) and
- the PTS of the AU

or

- the start APAT of the AU
- the end APAT of the AU (e.g. the end of the I-frame) and
- the PTS of the AU

or

- the start ATS of the AU
- the Access Unit End Map AUEM of the AU (for the end ATS of the AUs)
- the end ATS of the AU, based on AUEM, not AUSM, and
- the PTS of the AU.

It is possible to have a subset only of the above values, e.g. AUSM or AUSM and AUEM.

It is one object of the invention to disclose a method and a recorder for implementing trickplay modes in a data stream recorder. This object is achieved by the features disclosed in claim 1.

A trickplay mode, e.g. fast forward, is performed by selecting the desired AUs, e.g. each second AU, via AUSM/AUEM. The generation of AUSM, AUEM, AUSLL and AUELL during SOB recording is optional, i.e. is a matter of the manufacturer. The use of AUSM, AUEM, AUSLL and AUELL for trickplay modes is also optional. However, it is mandatory to update AUSM, AUEM and AULL in the case of editing. Fig. 3 to 5 show three examples.

The DVD Streamer specification defines the syntax of the

trickplay modes in a bitstream recorder, wherein the bitstream is organised in stream objects and access to the bitstream is performed using access units and access unit information is attached to the stream objects of the bitstream and to navigation data to be recorded, and wherein said access unit information includes an access unit start map, and optionally an access unit end map, which are used in the trickplay modes together with the navigation data for access to the bitstream.

Advantageous additional embodiments of the invention are disclosed in the respective dependent claim.

Drawings

Embodiments of the invention are described with reference to the accompanying drawings, which show in:

Fig. 1 simplified overall system for DVD Stream Recording;
Fig. 2 basic directory and file structure;
Fig. 3 access to application packet via AUSM and AULL;
Fig. 4 access to application packet via AUSM, but without AULL;
Fig. 5 access to application packet whereby AULL also contains end of AU information;
Fig. 6 table showing the maximum possible Access Unit support which is storable by a specific configuration;
Fig. 7 structure of a Stream Object Information;
Fig. 8 structure of the AUD_FLAG byte;
Fig. 9 structure of the Access Unit Data;
Fig. 10 example of an AUSM and its corresponding SOBUs;
Fig. 11 example of AUSM, AUSLL, AUEM, AUELL and the related data access mechanism.

Exemplary embodiments

Fig. 1 shows a simplified block diagram of a settop box AD and a Stream recorder device STRD. AD interacts via an interface IF, e.g. an IEEE1394 interface, with STRD. AD sends its data via output buffering & timestamping handling means BTHOAD to IF and receives from IF data via input buffering & timestamping handling means BTHIAD. A streamer STR within STRD sends its data via output buffering & timestamping handling means BTHO to IF and receives from IF data via input buffering & timestamping handling means BTHI.
Instead of an IEEE1394 connection any other network like the Ethernet or the Internet can be used.
Instead of a settop box any other data stream source can be used, e.g. a DVD player or a PC or Internet receiver. In that case ANT and TU is replaced by e.g. an optical disc and a pickup.

The DVD Stream Recording system is designed to use rewritable DVD discs for recording existing digital bitstreams, editing them and playing them back as bitstreams. This system is designed to satisfy the following requirements:

- A timing mechanism, i.e. a time stamp is added to every broadcast packet to enable proper packet delivery during playback.
- To enlarge the fields of applications, non-real-time recording should be possible. However, in this case the STB has to generate the timestamp information.
- Data allocation strategy and a file system to support real-time stream recording.
- Many digital services require Service Information which normally is embedded in the real-time stream. To support a STB fed by data from a DVD player, the DVD should provide additional space, which can be used by the STB to duplicate part of the service information and to add additional TOC information.

- Copy Protection must be supported. In addition, any scrambling performed by the service provider or the STB must be kept unchanged.

User requirements can be grouped into requirements for recording, requirements for playback, and requirements for editing:

Real-time Recording

The system is designed to enable real-time recording of digital streams. It allows the user to concatenate recordings, even if those recordings consist of different stream formats. If recordings are concatenated, a seamless or close-to-seamless playback feature can be achieved, but is not required.

Navigation Support

To support navigation two pieces of information (lists) are generated during recording:

1) An 'original' version of a play list. This list contains quite low level information, e.g. time map or (broadcast) packet order of the recording. This list is accessible by the STB and the content is understood by the DVD streamer as well as by the STB. In its original version the playlist enables the playback of a complete recording. The playlist may be accessed and extended after recording by the STB to allow more sophisticated playback sequences.

2) The second piece of information, a mapping list, is generated to support the stream recorder to retrieve packet stream chunks (cells), that are described in terms of the application domain, e.g. 'broadcast packets' or 'time'. This list is owned and understood by the DVD streamer only.

Content Description

The system can reserve space which can be used by the STB to store high-level TOC and Service Information. This information is provided for the user to navigate through the con-

tent stored on disc and may contain sophisticated EPG information. The content needs not to be understood by the stream recorder. However a common subset of the TOC information, e.g. based on a character string, may be useful to be shared between STB and DVD, in order to enable the stream recorder to provide a basic menu by itself.

Player menus for access unit selection

Playback of individual recording and playing all recordings sequentially is possible via a play list.

The STB can generate a sophisticated menu based on the TOC information stored on the disc. A simple menu is generated by the streamer itself, e.g. via some 'character' information which is shared by STB and DVD.

The DVD streamer creates the 'original version' of the play list. It can allow extensions and modifications of the play list by the STB for more sophisticated playback features. The DVD streamer is not responsible for the content of those sophisticated playlist(s).

The system supports the deletion of single recordings on user's request. Preferably the system allows this feature under the control of the STB.

The system may support insert editing.

Concerning the directory and file structure, the organisation of Stream Data and Navigation Data of DVD Stream Recording is done in a specific way such as to take into account the following:

- Any DVD Streamer device has certain requirements to store its own housekeeping data or Streamer-specific navigation data on the disc. These data are solely for helping the retrieval of recorded data; they need not be understood or even be visible to any outside application device AD.
- Any DVD Streamer device needs to communicate with the application device AD it is connected to. This communication is as universal as possible so that the maximum pos-

sible range of applications can be connected to the Streamer. The Navigation Data to support such communication are called Common navigation data and must be understandable by the Streamer as well as by the application device.

- The Streamer device offers to the connected application device AD a means for storing its own private data of any desired kind. The Streamer needs not to understand any of the content, internal structure, or meaning of this application-specific navigation data.

A possible directory and file structure is described in connection with Fig. 2. Under the root directory, the files storing the disc content are placed under the STRREC directory. Under the STRREC directory the following files are created:

- COMMON.IFO
  Basic information to describe the stream content. Needs to be understood by the Application Device as well as the Streamer.
- STREAMER.IFO
  Private housekeeping information specific to the Streamer Device. Needs not to be understood by the Application Device.
- APPLICAT.IFO
  Application Private Data, i.e. information that is specific to the Application(s) connected to the Streamer. Needs not to be understood by the Streamer.
- REALTIME.SOB
  Recorded real-time stream data proper.

Note that except for the files described above, the STRREC directory shall not contain any other files or directories.

The DVD Streamer Format Draft, version 0.3, realises trick play support by the Entry Point Data of Section 2.2.3.3.3. According to the invention, some of these features have been

revised in order to allow improved trickplay modes. The invention takes the following into account:

- The sector based addressing mechanism has been deleted.
- The wordlength of the time based addressing information has been changed from a 6 byte time value of the APAT type to a 4 byte time value of the ATS type. As a side effect, a second bit flag array AUEM has been introduced in parallel to the already existing AUSM. In this new format, the time based address information is not only more compact, but also more directly usable.
- All 'Entry Point XXX' terms have been renamed to 'Access Unit XXX' in order to avoid confusion with the user controlled Entry Points in Cell Information, which still exist.

The invention can also be used without value AULL.

As shown in Fig. 7 the Stream Object Information SOBI includes the Stream Object Information General Information SOBI_GI, the Mapping List MAPL and the Access Unit Data AUD, if any. The mapping list includes incremental application packet arrival times and is described in more detail in EP 98250387.2 of the applicant.

SOBI_GI may have the following format:

	Contents	Number of Bytes
(1) SOB_TY	SOB Type	1
(2) SOB_REC_TM	SOB Recording Time	5
(3) SOB_STI_N	SOB Stream Information Number	1
(4) AUD_FLAGS	Access Unit Data Flags	1
(5) SOB_S_APAT	SOB Start APAT	6
(6) SOB_E_APAT	SOB End APAT	6
(7) SOB_S_SOBU	first SOBU of this SOB	4
(8) MAPL_ENT_Ns	number of Mapping List entries	4
	Total	28

tion packet inside the SOBU associated with this entry. When data readout has begun at the start of the SOBU, these AU_ATS are identified by comparing them with the individual ATS of the Application Packets inside the bitstream data. Fig. 11 shows an example of AUSM, AUSLL, AUEM, AUELL and the related data access mechanism.

The Presentation Time Stamp List PTSL is the list of the Presentation Time Stamps of all the Access Units of the SOB, i.e. if PTSL exists, each Access Unit has exactly one corresponding PTSL entry, and PTSL then has AU_Ns entries. The entries of PTSL are in ascending order, i.e.

- the first PTSL entry is associated to the Access Unit occurring first inside AUSM
- the second PTSL entry is associated to the Access Unit occurring second inside AUSM
- and so on.

Each PTSL entry is defined as

	Contents	Number of Bytes
(1) PTS	PTS of the corresponding Access Unit	4
	Total	4

The entries of the table depicted in Fig. 6 show the maximum possible Access Unit support which is storable by the described configuration. This is the performable support just *after* an SOB recording. If an entry consists of two states, separated by a slash, that entry describes the following:

- left side of the slash: the status just after the recording of a SOB
- right side of the slash: the status after a second offline session, e.g. an hour at night.

Some explanations for using this Access Unit Support table:
SOBU desired application packet is in the indicated SOBU;
2 SOBU desired application packet is in the indicated SOBU

or in the following SOBU;

APAT complete APAT of the desired application packet. The streamer is not able to calculate directly the sector and application packet number from the APAT, i.e. an access to the application must be performed via the MAPL;

packet exact and direct application packet location. The location is given by a sector number and the application packet number inside this sector.

Different DVD Streamer types are listed horizontally:

- simple Streamer, less memory:
  A streamer without any dedicated knowledge about the application STB. The streamer has just enough RAM to store a coarse list which indicates the SOBUs containing an AU.
- Streamer is simple but additional memory is available:
  Similar to the previous streamer. The only different is
  a) just enough memory for AUs: the streamer has additional RAM to store the complete AU information (a coarse list + AU start location + AU end location + PTS);
  b) more memory: the streamer has additional RAM to store the complete AU information (coarse list + AU start location + AU end location + PTS) and the exact packet location + ATS inside the RAM for each incoming application packet during recording.
- Streamer with dedicated hardware to parse streams, less memory:
  the streamer has just enough RAM to store a list which indicates the SOBUs containing an AU. The streamer knows the application, i.e. the streamer is able to find the AUs (start, end and PTS) during recording and playback due to the implemented stream parser.
- Streamer with dedicated hardware to parse streams, additional memory is available:
  this streamer has additional RAM to store the complete AU information (coarse list + AU start location + AU end lo-

cation + PTS). The streamer knows the application, i.e. the streamer is able to find the AUs (start, end and PTS) during recording and playback due to the implemented stream parser.

Various application device types are listed vertically:

- simple STB:
  the application is not aware of the existence of the streamer.
- STB sends AU list after recording:
  the application knows that a streamer records the sent application packets. After recording of a take (SOB) the application sends a list of AU information (AU start ATS + AU end ATS + PTS) to the streamer.
- STB sends AUs during recording:
  the application knows that a streamer records the sent application packets. During recording of a take (SOB) the application sends in parallel, e.g. via an isochronous channel, AU information (AU start ATS + AU end ATS + PTS) to the streamer.

The navigation data related to one Access Unit includes four items of information:

- coarse:
  coarse list. The list describes the SOBUs which have an AU.
- fine:
  fine list. This list describes the unambiguous location of the AU either as APAT or as sector number + application number inside this sector.
- last:
  fine list of the last application packet which belongs to this AU. It's also a list of the unambiguous location of each AU either as APAT or as sector number + application number inside this sector.

- PTS:
  list of PTSs. Each AU has exact one PTS.
- stream:
  means AU marks inside the stream. If 'yes' the stream contains additional information for the streamer to detect such application packets which contain an AU start or an AU end.

unit start map (AUSM) and optional one or more of access unit end map (AUEM), access unit start location list (AUSLL) and access unit end location list (AUELL).

6. Method or recorder according to claim 5 wherein, if the access unit end map (AUEM) exists, for each access unit start map (AUSM) entry an access unit end map (AUEM) entry is provided.

7. Method or recorder according to claim 5 or 6, wherein the index of each access unit end map entry is equal to or greater than the entry index of its corresponding access unit start map entry and is less than the index of the immediately following access unit start map entry if any following access unit start map entry exists.

Abstract

Stream recording assumes e.g. a settop box to be connected to a DVD Streamer. The connection is e.g. of IEEE1394 type using interfaces including transmitting and receiving firmware. Stream Data include one or more Stream Objects which each can be stored as a Program Stream as described in ISO/IEC 13818-1, Systems. The invention allows to realise Access Units in such DVD Streamer. Each Stream Object contains its own Access Unit data. A trickplay mode, e.g. fast forward, is performed by selecting the desired Access Units which are derived from a mapping list with incremental application packet arrival times.

Fig. 3

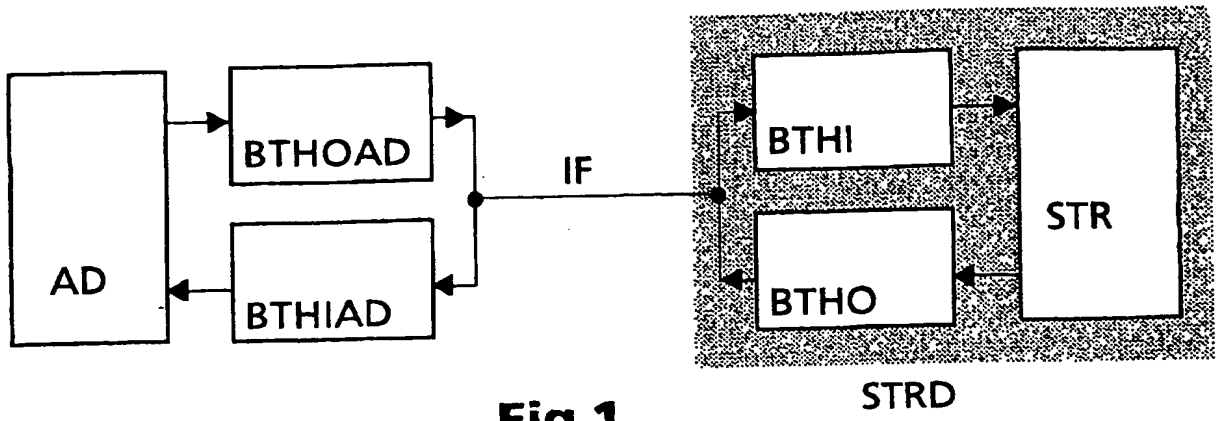

Fig.1

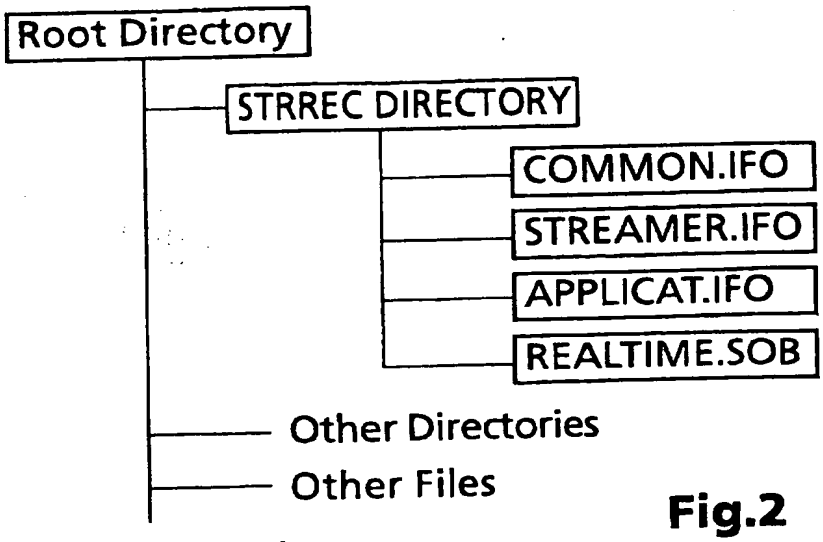

Fig.2

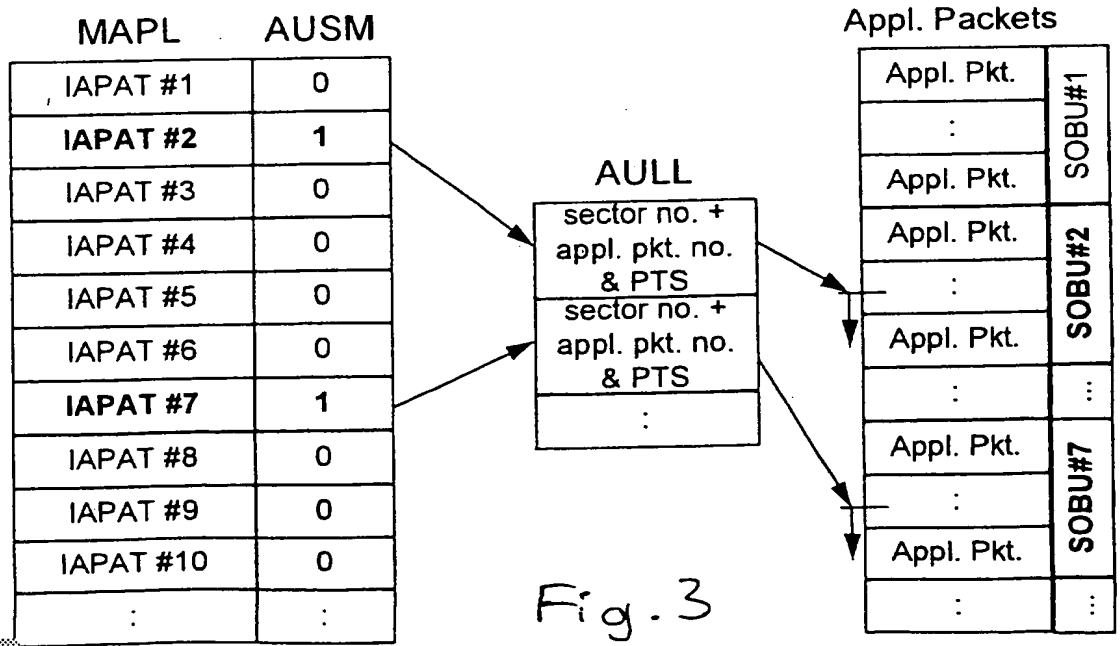

Fig. 3

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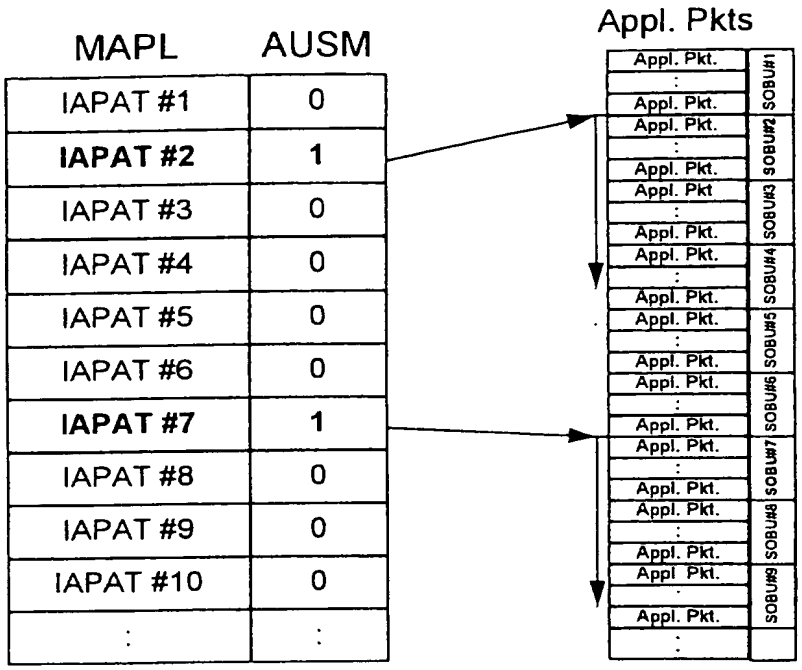
MAPL
AUSM
IAPAT #1
0
IAPAT #2
1
IAPAT #3
0
IAPAT #4
0
IAPAT #5
0
IAPAT #6
0
IAPAT #7
1
IAPAT #8
0
IAPAT #9
0
IAPAT #10
0
Appl. Pkts
Appl. Pkt.
SOBU#1
SOBU#2
SOBU#3
SOBU#4
SOBU#5
SOBU#6
SOBU#7
SOBU#8
SOBU#9

Fig. 4

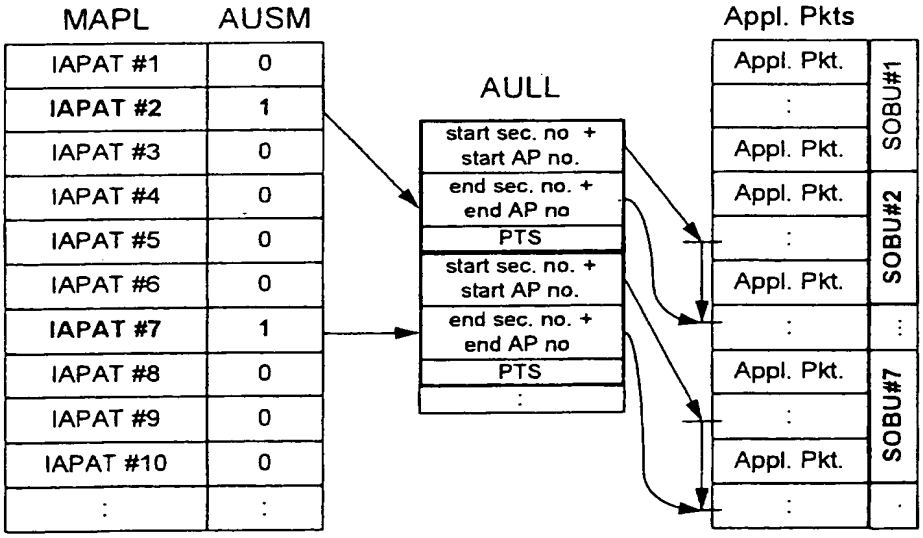
MAPL
AUSM
IAPAT #1
0
IAPAT #2
1
IAPAT #3
0
IAPAT #4
0
IAPAT #5
0
IAPAT #6
0
IAPAT #7
1
IAPAT #8
0
IAPAT #9
0
IAPAT #10
0
AULL
start sec. no + start AP no.
end sec. no. + end AP no
PTS
start sec. no. + start AP no.
end sec. no. + end AP no
PTS
Appl. Pkts
Appl. Pkt.
SOBU#1
SOBU#2
SOBU#7

Fig. 5

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STB	Streamer	simple Streamer, less memory	Streamer is simple, add. memory is avail. just enough for AUs	more memory	Streamer with dedicated hardw. to parse streams, less memory	Streamer with dedicated hardw. to parse streams, add.mem.is avail.
simple STB	coarse	-	-	-	SOBU	SOBU
	fine	-	-	-	- / packet	packet
	last	-	-	-	- / packet	packet
	PTS	-	-	-	- / yes	yes
	stream	-	-	-	yes	yes
STB sends AU list after record.	coarse	2 SOBU/SOBU	2 SOBU/SOBU	SOBU	SOBU	SOBU
	fine	APAT/packet	APAT/packet	packet	APAT/packet	packet
	last	APAT/packet	APAT/packet	packet	APAT/packet	packet
	PTS	yes	yes	yes	yes	yes
	stream	- / yes	- / yes	- / yes	yes	yes
STB sends AUs during record.	coarse	SOBU	SOBU	SOBU	SOBU	SOBU
	fine	- / packet	packet	packet	- / packet	packet
	last	- / packet	packet	packet	- / packet	packet
	PTS	-	yes	yes	- / yes	yes
	stream	yes	yes	yes	yes	yes

Fig. 6

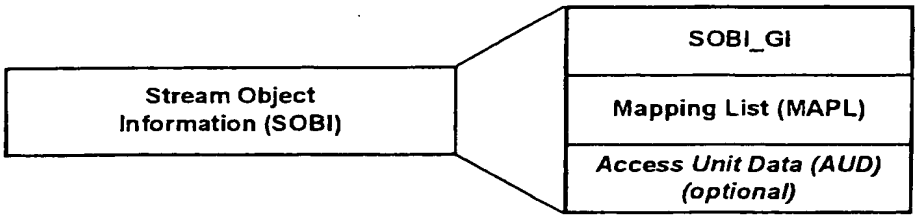

Fig. 7

b7	b6	b5	b4	b3	b2	b1	b0
RTAU_ FLG	AUD_ FLG	AUSLL_ FLG	AUEM_ FLG	AUELL_ FLG	PTSL_ FLG	reserved	

Fig. 8

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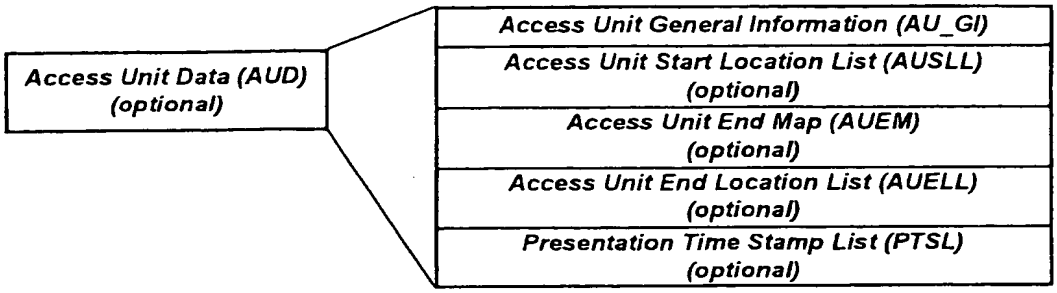

Fig. 9

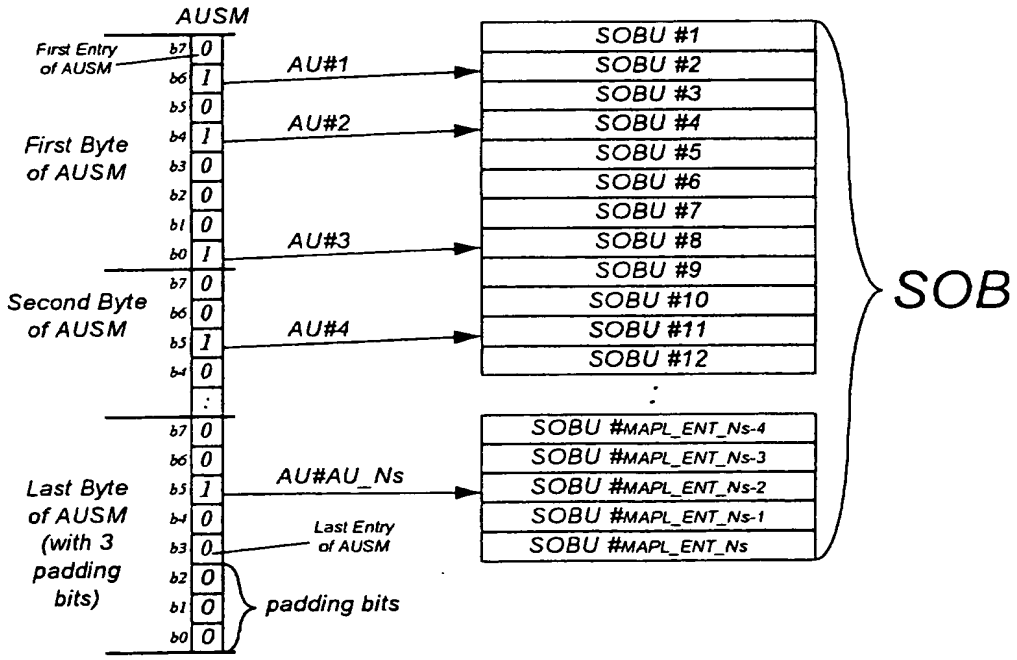

Fig. 10

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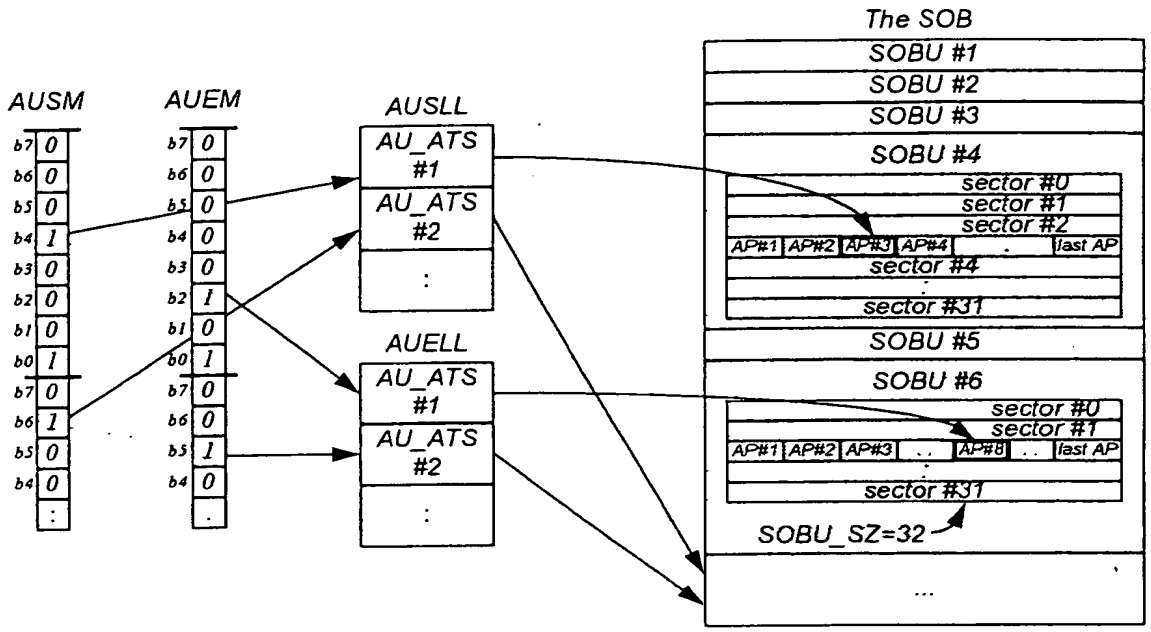

Fig. 11